A SYNOPSIS OF THE THESIS

TITLED

“A study of aquaculture management and current state of shrimp farming practices in Choryasi and Olpad taluka of Surat district, Gujarat.”

SUBMITTED TO

VEER NARMAD SOUTH GUJARAT UNIVERSITY,

SURAT.

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Registration number: 3077

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UNDER THE GUIDANCE OF:

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2014.

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I INTRODUCTION

Aquaculture has been defined by FAO as “The farming of aquatic organisms including fish, molluscs, crustaceans and aquatic plants. Farming implies some form of intervention in the rearing process to enhance production, such as regular stocking, feeding, protection from predators, etc. Farming also implies individual or corporate ownership of the stock being cultivated."

Aquaculture is different to the traditional capture fisheries by the fact that unlike capture fisheries which involves only hunting, aquaculture is an activity where by the species are raised in enclosed grow out systems like ponds and are cultured up to its consumable size and proportions. Aquaculture is a system where in a dedicated environment is created where in the species are grown for human consumption.

According to an estimate the world population is expected to grow to nearly 9.6 billion by the year 2050, which results into an ever increasing demand for seafood which the traditional capture fisheries cannot fulfill.

The market for aquaculture products is massive. It is one of the fastest growing food production sectors in the world. With over-exploited marine fishery resources, the importance of aquaculture has increased with the expectations of reducing the gap between the supply and demand of fish products for the ever increasing population of the world.

There has been a steady growth in the global fish production during the last five decades, with food fish supply increasing at an average annual rate of 3.2 percent, outpacing world population growth at 1.6 percent. The World per capita fish consumption also increased from an average of 9.9 kg in the 1960s to 19.2 kg in 2012(fao).

India, with a favorable demographic and good availability of resources, enjoys a competitive edge over most of the other countries in the world in terms of fisheries sector.

Asia continues to dominate the world aquaculture market where in nearly 90% of the world’s aquaculture production comes from Asia. India currently ranks second in the world in terms of aquaculture production, only next to china. However relatively, India produces only about $1/20^{th}$ of what china produces annually.

Indian aquaculture industry is growing; however there are still issues of unutilized resources and bottlenecks, which have limited the growth of the sector.

Among the Indian states, Gujarat has been a major producer of fishery products, both marine and aquaculture. Gujarat state possesses rich and diversified fisheries resources. A long

coastal-line of 1600 kms., which is broken by several bays, inlets, estuaries and marshy lands, widest continental shelf with an area of 1.64 lakh Sq.Kms., Brackish water area of 3.67 lakh Ha., are some of the unique features of Gujarat's marine topography.

Aquaculture not only provides solution for the problem of food security to the growing population, it also has a huge potential for earning foreign exchange. A major portion of the total production of aquaculture is exported, to countries like, USA, Europe, EU, etc thereby creating an inflow of foreign exchange.

Aquaculture is considered to be a high risk high return sector. On one hand where it has a potential to generate huge returns, on the other hand it also demands high risk taking ability as an aquaculture farmer. Careful handling at each stage of its operation and appropriate preventive measures must be ensured for its success.

II ABOUT THE RESEARCH PROBLEM

The production cycle of the shrimp in aquaculture system, generally goes through following stages: hatchery operations (cultivation of seeds of shrimp), grow out operations, where in the seeds are cultured into consumable size shrimps in ponds and finally the post harvest stage where in the final crop of shrimps are processed and made suitable for exports.

This study entitled "**A study of aquaculture management and current state of shrimp farming practices in Choryasi and Olpad taluka of Surat district, Gujarat.**" is an effort to study the farming practices adopted by the shrimp farmers cultivating shrimps in the Choryasi and Olpad Taluka, region of Surat District. The study focuses on the grow out stage of operations in the overall cycle of production.

In Gujarat shrimp aquaculture is concentrated to mainly brackish water areas where in there is an adequate supply of seawater. The shrimp aquaculture in Choryasi and Olpad talukas uses brackish water from the Arabian Sea for their culture operations. Shrimp farmers in these regions generally cultivate only two species of shrimps, P. Monodon and P (L) Vannamei. In recent times as a result of availability and economic advantage more and more shrimp farmers are cultivating vannamei species in their ponds.

An effort has been made by this study to understand the management practices and techniques adopted by the farmers in the region during the cycle of culture. Olpad Taluka possesses higher number of ponds for shrimp culture as compared to Choryasi. This study makes an attempt to understand the factors that are crucial for a successful crop.

In recent times, aquaculture industry has been through rough times, with the occurrence of diseases, social resistance and regulatory pressures to mention a few. The study also tries to identify such problems faced by the farmers of this region and understand its implications.

III REVIEW OF LITERATURE

A paper entitled "A comparative study of the aquaculture practices adopted by fish farmers in Andhra Pradesh and West Bengal" by T. JAWAHAR ABRAHAM, S. K. SIL AND P. VINEETHA (Faculty of Fishery Sciences, West Bengal University of Animal and Fishery Sciences Chakgaria, Panchasayar P. O., Kolkata - 700 094, West Bengal, India) studies the socio economic profile of the fish farmers and the aquaculture practices of Andhra Pradesh and West Bengal, India. The study covered 153 farms culturing Indian major and minor carps. It presented the comparative analysis of the socio economic variables for the carp farmers in the two states along with the practices and the role of government policies towards aquaculture.

The paper entitled "shrimp culture In Asia and the Far East: a preliminary review" by G.L. Kesteven and T.J.Job (FAO fisheries and biology branch, Rome, Italy) deals with the cultivation of shrimp in Asian countries. The paper presents an overview of different culture systems adopted in various countries of the Asia region. The paper deals with the status of areas like Philippine, Indonesia, java, Kerala and Singapore in regard to the culture of p Monodon species of shrimp.

Knowledge of shrimp growth rate is important to shrimp aquaculture management. In 1975, several tests were conducted to determine the growth rate of the juvenile shrimps and to assess effects of injected florescent pigment mark on the growth and mortality rates by E. Eric Knudsen, William H herke and John M Mackler at the Louisiana state university, under the study entitled "the growth rate of marked juvenile brown shrimp, P aztecus in a semi impounded Louisiana coastal marsh".

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Rajnarayan Indu and Santanu Ghosh undertook the study "INLAND FISHERY IN A TRADITIONALLY VEGETARIAN STATE: A GUJARAT STORY" to understand the factors which have caused explosive growth in culture fisheries in Gujarat. the study

investigate the role of institutions that nurturing the development of fisheries as a profitable economic endeavor through a 'real deal' in rural environment, and also the role of governance of such institutions for long-term growth and sustainability.

A study on "Comparative Growth Analysis of Litopenaeus Vannamei in Different Stocking Density at Different Farms of the Kottakudi Estuary, South East Coast of India" by A.Karuppasamy, V.Mathivanan and Selvisabhanayakam, carried out a comparative analysis in the Ramanathapuram district, south east coast of India. Parameters such as stocking density, pH levels, dissolved oxygen, ammonia were studied in order to evaluate the growth of L. vannamei shrimps in selected ponds.

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In a paper entitled 'aquaculture potentials and investment opportunity in shrimps and prawns farming in Nigeria' sogbesan, A.O., Olowosegun, T. Ibiyo, LMO Tafida and Musa YM. Studied the shrimp and prawn farming prospects and investment opportunity in Nigeria. The paper also highlights the management strategies needed in practical practices of shrimp and prawn culture.

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restricts the development in the developing countries. The study also suggests developing an integrated training program which includes several sources of knowledge into a common framework in order to understand and manage and analyses the fishery process.

In the study of "Aquaculture: Challenges and Promise" by Peter J. Allen (2011) focuses on the food and other requirements for the culture aquaculture systems and also as how it affects the overall growth and productivity of the culture fisheries.

In the study of **"**Comparative evaluation of two farming practices of penaeus Monodon (fabricius, 1798) in low saline waters of Andhra Pradesh, India" by S. Laureatte, P. P. Suresh Babu, g. Venugopal, R. S. Biradar, v. Narashimacharyulu and P. Mohan das (2012), performance evaluation of two different culture systems of P. Monodon namely extensive and semi-intensive farming in low saline waters was carried out in west Godavari district of Andhra Pradesh, India.

The problem of increasing feed rate and continuously decreasing market rate for Shrimps around the world was studied in the paper "Effect of feeding rate and pond primary productivity on growth of litopenaeus Vannamei reared in inland saline waters of west Alabama" by Luke A. Roy , D. Allen Davis & Gregory N. Whitis, department of fisheries and allied aquacultures, auburn university. During the study the productivity of the shrimps were observed during varied levels of feeds during the stages of culture. The results of the study indicated that a certain species of shrimps (L. vannamei) are capable of obtaining large proportion of the nutrition from the pond, thereby increasing productivity and allows reduction in feed costs and eventually profitability.

Pradeep K. Katihaa; J. K. Jenab; N. G. K. Pillai C ; Chinmoy Chakrabortya; M. M. Deyd in their paper "Inland aquaculture in India past trend, present status" (2005) studied the trends of aquaculture practices during the period of 1984-85 to 2002-03. They also studied the aquaculture systems and the economic considerations of the various activates of the industry. The paper also covered the study of returns to inputs for different fresh water aquaculture systems.

Ling Cao (CAO 2012) in his works "Farming shrimp for the future: a sustainability analysis of shrimp farming in china" undertook a socioeconomic survey of shrimp farmers in china to evaluate system profitability, disease risk and the change in the quality of life

In their study **"Aquaculture—opportunities and challenges special issue introduction"**, F**rank Asche, Atle G. Guttormsen, Ragnar Tveteras** (2008) showcased the risk element in aquaculture industry. They identified that the aquaculture industry had very high risk but along with the risk there were also high growth and high return as well.

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CIBA conducted a conference on **"New vistas in Indian aquaculture"** where in matters like improvement of technology in aquaculture, intensified aquaculture systems for better environmental and social concerns, diversification of species in aquaculture, effects of pollution, diseases, availability of quality feeds on aquaculture productivity, development of linkage between farms and markets and other issues were discussed.

B. Meenakumari from Indian council of agricultural research, New Delhi in her paper **"Prospects of fisheries and aquaculture in India"** studied the future prospects of freshwater and coastal aquaculture in India.

James L Anderson in his studies **"Shrimp production estimates and trends"** (2010) studies shrimp aquaculture industry in five different regions around the world. These regions were Southeast Asia, China, India/Bangladesh, America, Africa/middle east. The studies ranged in the period of 2004 to 2012. His studies also focused on the issues and challenges in shrimp aquaculture. His analysis of these issues and challenges were rated on the basis of Not Important, Moderately Important and extremely Important. The study also compared the prices of P.monodon and P vannamei along with the export trends.

Dr. Francis Murray from the institute of aquaculture, university of sterling began his study **"Asian farmed shrimp & prawns sustainability myths & reality"** with an aim to compete current sustainability of shrimp farming against the outcome of the study carried out in Asian shrimp producing countries. He covered all the three systems of aquaculture i.e. intensive, extensive and semi intensive. His study covered Thailand, China, Vietnam, and Bangladesh.

The importance and the need of better practices approach in culture based fisheries was studied in the **"Better-practice approaches for culture-based fisheries development in Asia"** by **De Silva S. S., Amarasinghe A. S., and Nguyen T. T. T**. (eds), 2006. The study focused on adopting better practices in various stages of culture fisheries from selection of water bodies to the marketing of the final crop. The paper also discussed about the constraints and future prospects faced by the Culture Based fisheries. The study covered Culture fisheries in Sri Lanka and Vietnam.

In the study of **"Comparative evaluation of two farming practices of penaeus monodon (fabricius, 1798) in low saline waters of Andhra Pradesh, India"** by **S. Laureatte, P. P. Suresh Babu, g. Venugopal, R. S. Biradar,v. Narashimacharyulu and P. Mohan das** (2012), performance evaluation of two different culture systems of P. Monodon namely extensive and semi-intensive farming in low saline waters was carried out in west Godavari district of Andhra Pradesh, India.

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Theresa Burns, university of calgary, Canada (2012) in her work **"Networks, collectives, and social learning in aquaculture bridging the information to implementation gap"** studied as to how the knowledge and the social learning's benefited the shrimp farmers of Sri Lanka. The study also covered the linkages of shrimp farmers and the Sri Lankan aquaculture organizations.

"Research needs to sustain Asia-pacific aquaculture to year 2025 and beyond" which was funded by the international development research cooperation, Canada (IRDC) (2007) focused on the factors affecting the aquaculture industry and the innovation required for a sustainable growth up to the year 2025 in the Asia pacific region. Climate Change, Bio diversity in aquaculture, issues in health hazards, integrated fish farming, feed management, effective utilization of land and other resources, socio economic issues, etc.

In a paper titled **"Role of socio-economic factors to determine technical efficiency of shrimp farmers of Bangladesh"** by **Sadika H.□ ,Siegfried B., Madan M. D. Nazmul H. And Puran M.** (2012) measured the technical efficiency of the shrimp farmers in Bangladesh using translog production frontier and inefficiency effect model. The study suggested that there exists high level of inefficiencies in the shrimp cultivation.

"In to the next millennium : fishery perspective" by **Veravat Hongskul** FAO, (November 1999) focused on the historical perspective as well as the current state of fisheries and aquaculture in the Asia pacific region. The study also covered the future prospects along with the demand and supply factors for the future. Hongskul emphasized that the continued population growth in Asia and the resulting high demand for fish and fishery products, are far beyond the productivity of traditional and capture fishery resources in the region. He suggested that In order to ensure continued supplies of fish and fishery products in the region, all States are encouraged to implement the Code of Conduct for Responsible Fisheries in their jurisdiction along with Necessary actions should be undertaken, in close cooperation between the public and private sectors and between members governments and regional bodies, to eliminate excess fishing capacity, to improve fisheries management, to develop aquaculture as an integral part of national rural development, to minimize wastages and discards in post-harvest operations.

Maureen Aylward in his paper titled **"Aquaculture industry challenges and opportunities" (**2011) Mentioned as to how there are possibilities of different species being cultivated in aquaculture which can be farmed as and when the need arises. the paper mentioned as to how these technological breakthroughs are proving cost effectiveness in comparison to existing practices.

In the study of **"Aquaculture: Challenges and Promise"** by **Peter J. Allen** (2011) focuses on the food and other requirements for the culture aquaculture systems and also as how it affects the overall growth and productivity of the culture fisheries.

In the paper entitled **"commercial pond fish culture"** S.A.WOKOMA, discussed the need of fulfilling the demand for fish in Nigeria, be establismenet and development of commercial pond based fish culture. The objective was to increase fish production with the help of aquaculture, by construction of water tight ponds with suitable soil, both in fresh water and brackish water swamps, and thereby cultivating the suitable species of fish in these ponds. The paper deals with the operational requirements for setting up of a commercially viable culture system in Nigeria, along with an economic perspective of all the expenses and costs relevant for setting up of such ponds.

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A paper entitled "refining shrimp culture methods: the effect of temperature on early stages of the commercial pink shrimp" by Anitra Thorhaug, Tom Devany and Barbara Murphy (rosenstiel school of marine and atmospheric science, university of Miami) studies the effect of temperature and as a result to ascertain the optimum and safe ranges for rearing of the larval forms and device methods which would allow a rapid growth of shrimps.

In studies undertaken by the title "pond cultivation of shrimp in south carolina" by G. Robert Lunz, it was found that by stocking the ponds with small shrimp and keeping the number of predator fishes to minimum, production can be considerable increased.

The paper entitled "shrimp culture In Asia and the far east: a preliminary review" by G.L. Kesteven and T.J.Job (FAO fisheries and biology branch, rome, italy) deals with the cultivation of shrimp in Asian countries. The paper presents an overview of different culture

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"Improvement of traditional shrimp culture in the makong delta" by Truong Trond nghia, Vu ngoc Ut, Nguyen Kim Quang and A.J. Rothuis, discussed how the traditional Vietnamese shrimp farmers who mainly carried extensive techniques are attempting to change it with the help of a technical support program called improved extensive shrimp culture method. This program focuses on areas like use of hatchery produced post larve, application of low cost pond management practices among others for improved culture performance.

"pond culture of shrimp on grand terre island, Louisiana, 1962 - 68" by J.G. Broom, discusses the behavior of four different shrimp species in culture ponds with adjusted feeding rates to the increased growth without regard to possible mortality. Factors like stocking density, production, handling, growth and feeding, mortality etc were measured and observed during the course of the study.

In 2013, SUSHIL SUBHAS SOLANKE, M. KRISHNAN, C. SARADA, B. NIGHTINGALE DEVI, I. SIVARAMAN AND BANTI DEBNATH (Fisheries Economics, Extension and Statistics Division, Central Institute of Fisheries Education, Mumbai - 400 061 Maharashtra, India) undertook a study entitled "Production, price spread and marketing efficiency of farmed shrimp in Thane District of Maharashtra" to determine the production input – output relationships, to understand the existing marketing channels for shrimp and to evaluate the price spread and marketing efficiency of these channels. The study was carried out on 66 shrimp farmers from three villages. The shrimp farms were classified according to the types of land holdings and the returns from harvested crop according to the size of the shrimps were observed.

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cooperative record were used to carry out the study. Management practices of both these districts were not found to be scientific.

In a paper entitled "Economics of Shrimp Farming: A Comparative Study of Traditional Vs. Scientific Shrimp Farming in West Bengal" Poulomi Bhattacharya (The Institute for Social and Economic Change, Bangalore) attempted to analyse the economic viability of the alternative shrimp farming systems from a long term perspective in the context of household level shrimp farming in west Bengal, by incorporating the costs incurred due to generation of negative externality and the risks associated with shrimp farming.

An article by Dararatt Anantanasuwong entitled "Shrimp Farming in Coastal Areas in Thailand and the Proposed Economic Instruments for Sustainable Shrimp Farming" highlited the problems faced by the shrimp farmer related to the coastal zone management in Thailand. It also focused on the production process of shrimp farming, which has impact on environment and other shrimp farms in the region.

How the location of a farm can bring out better results in prawn farming was discussed in the paper entitled "Optimizing prawn farm locations for environmental and economic benefits" by Andrew J. Tyre, Ian Mcleod, Francis Pantus, Nigel P. Preston, Donna Brennan (Australia). The paper identified five key priorities such as: minimize flood risk, preserve economic viability of sugar industry, preserve freedom of choice, water in and out, with no other added environmental load. Each of these parameters were assed based on individual models

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IV OBJECTIVES OF THE STUDY

RESEARCH OBJECTIVES:

- To study the **shrimp farming practices** adopted by shrimp farmers of Choryasi and Olpad taluka of Surat District.
- To identify the **problems and issues** faced by the shrimp farmers in the region
- To study the **factors affecting the productivity** of shrimp and their role in the overall culture management
- To study the **aquaculture management practices** adopted by shrimp farmers in the region.
- To study the **risk management practices** related to shrimp aquaculture.

V SCOPE OF THE STUDY

- The study is undertaken in the Choryasi and Olpad Taluka, of Surat District.
- The target population covers only the farmers/units engaged in shrimp aquaculture farming, in these two taluka.
- Farming practices refers to only the practices adopted by the shrimp farmer in the shrimp grow out phase of the entire cycle. The study does not include the practices of hatcheries and post harvest practices by the shrimp processing units.
- Aquaculture management refers to only the culture management in ponds during the culture period.
- The study of performance and productivity trend is up to the year of 2014.

VI DATA SOURCES

The Information and data in the thesis are obtained from the following sources:

Primary Source of Data:

- **Questionnaire:**

  Response collected from the shrimp farmers in Choryasi and Olpad Taluka.

- **Personal Interview:**
  - With selected farmers in both the taluka
  - With selected Feed and seed suppliers/dealers in both the taluka
  - With Selected Technicians, providing advice and consultation to shrimp farmers in both the areas
- **Personal visits to shrimp farms in both the taluka.**

Secondary Source of Data:

- Data and records collected from government agencies (Commissioner of fisheries' office, Surat.)
- Published reports of government and semi government agencies

Data and information published by government agencies and agencies in the field of fisheries and aquaculture like annual reports, statistical handbooks, reports and other

- Books and magazines on the subject
- Magazine articles, newspapers and other published source of information.
- Website and other online resources.

IMPORTANCE OF STUDY:

- The study will help understand the common practices adopted by the shrimp farmers in the region.
- The study will help to identify the relation of Productivity of the shrimp farming units in relation to inputs.
- The study will help understand the challenges faced by the shrimp farmers and discover possible reforms to overcome those challenges
- The study will identify the better management practices for the shrimp farmers there by increasing the productivity of their units.

LIMITATIONS OF THE STUDY

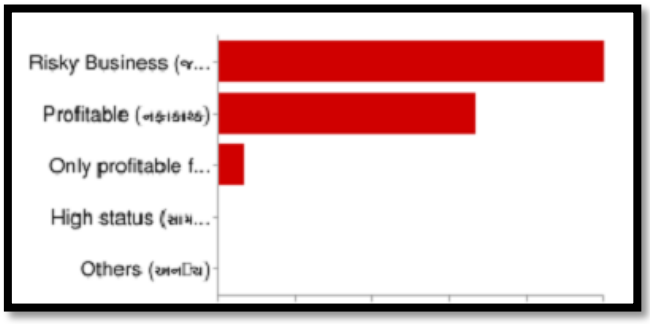
- The study focuses on the practices followed by the shrimp farmers of Choryasi and Olpad Taluka regions, these practices may or may not be followed by other shrimp farmers across the state.
- Many shrimp farmers hesitated to respond to the questionnaire and disclose their information

SUMMARY OF FINDINGS:

A survey was undertaken in Choryasi and Olpad taluka of Surat district, in order to study the shrimp farming practices adopted by the brackish water shrimp farmers in these region and further to identify variations if any, in the practices adopted by the shrimp farmers of Choryasi and Olpad taluka.

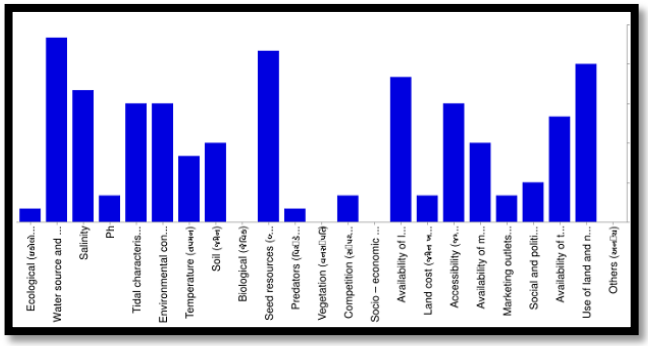
Following observations were made during the study

- 93.8% of shrimp Farmers in the region perceived shrimp aquaculture as risky business. Shrimp aquaculture is considered to be highly profitable as well by the shrimp farmers.



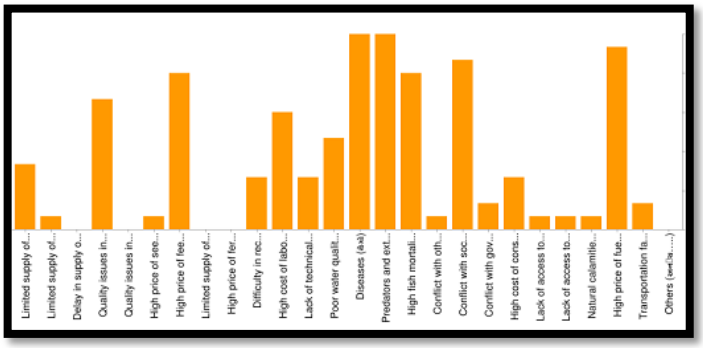
- The selection of site for the construction of ponds and facilities depends highly on the availability of land resources and nearby areas. Gujarat government's department of fisheries has initiated efforts and allocated land to the beneficiaries in the Olpad taluka for the purpose of shrimp farming. However no such allocation of land is undertaken in Choryasi taluka.

- Among the key characteristics expected by the shrimp farmers for suitable shrimp farming location, water source and salinity are considered to be of high importance. Water is one of the most important ingredients for successful shrimp aquaculture farming.



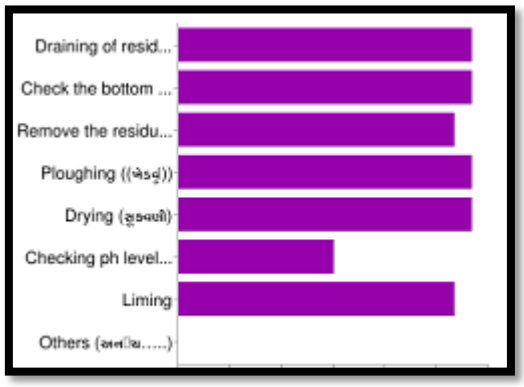
- Shrimp farmers in Choryasi and Olpad carries out semi-intensive farming of shrimps, and adopts monoculture of species for their culture. Among the two shrimp species more than 90% farmers in cultured P. vannamei for culture as compared to P monodon (tiger). In recent years there has been a growing use of vannamei shrimps in the regions as a result of easy availability of seeds and better economic value.

- More than 90% of the shrimp farmers experienced an attack of diseases causing mortality of shrimps and external predators in past. Among the other problems high price of feed, quality issues in seeds, higher cost of fuel and electricity were also observed. The shrimp farmers in Olpad and Choryasi taluka also encountered conflict with society over past few years



- Pond preparation

Shrimp farming activity started with pond preparation. New cycle begins with draining of the residual waters which is left over after the last harvest. Careful removal of left over shrimps and residual is done and any waste matter is carefully disposed off.



Control of effluent from the last production cycle is drained away and the pond bottom sediments are removed from the pond before drying.

- Drying

First the raking of pond bottom soil done by tractors and bottom was made to expose to sun for sun drying till the bottom was fully dried. Depending on the farming cycle pond bottom is exposed to drying until the bottom starts forms cracks. Once the cracks are formed the pond is leveled back using tractors.

Sun dried pond

ploughing of bottom by tractor

PE LINING IN PONDS

POND BOTTOM AFTER LEVELING

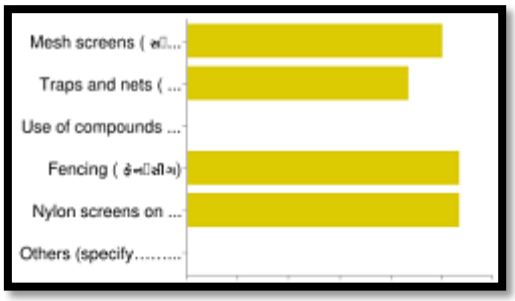
- Water filling

Sea water from tidal currents is the source of water for shrimp aquaculture farms. The water is allowed to enter the farm area via a network of creeks and canals. This brackish water from sea serves as an only source of water for shrimp farming aquaculture in the area.

Farmers must rely on the lunar periodicity and tidal movements in order to obtain the desired quantity of water for their farms.

The water is first accumulated in the reserve ponds (reservoir) where in the sea water is filtered through nylon mesh net to avoid entry of any larvae of predatory fish or other organisms and treated with different disinfectants before introducing the water in the culture ponds. The pond water was disinfected by using bleaching powder which kills all unwanted fishes and pathogens or virus present in the water.

Predator control allows the farms and the premises to be free from external threats like birds, animals, and other external threats.



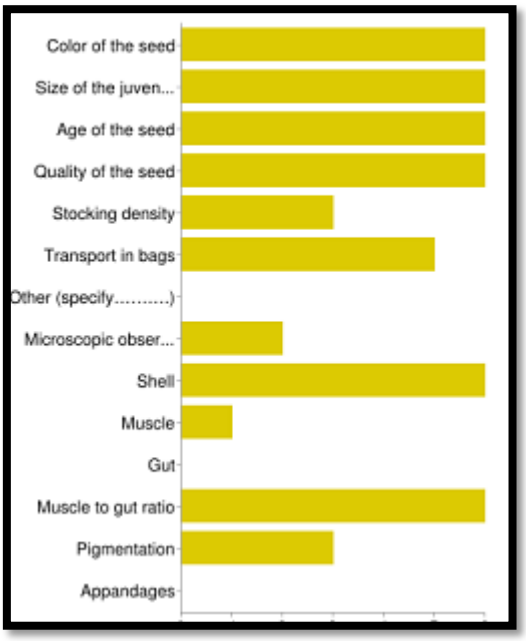
Bird fencing and crab fencing are a common practice in the regions which restricts their movement around the ponds. Along with the fencing farmers also uses screens and nets in order to keep away the predators.

- Stocking of shrimp seed

The Southern states like Tamil Nadu, Andhra Pradesh, and Kerala are the markets for shrimp farmers to buy the seed of tiger shrimp. Some of the farmers depended on the

state hatcheries itself. However for convenience and ease of availability, many of the farmers prefer to source the seeds from local traders and dealers.

SHRIMP SEED



Seeds are exposed to a series of tests and treatments at the hatcheries like, color, age of the seeds, biographic characteristics to ensure a virus free and safe seeds for culture operations.

The stocking density practiced by the shrimp farmers of the state varied from 3 to 10 nos / m2. When the color of the pond water turned to light greenish, stocking was done. There were mainly two methods for stocking the shrimp seed i.e. Splashing and tank aeration.

i) Splashing

In this method the seed bags were kept in corner of the pond by tying with small rope. After that the seed bags were opened and kept floating and then 1 -2 persons sprinkled the water over the opened seed bags from one side. This process was done for two hours just to acclimatize the seed to the pond water. After this the seed were slowly released into the pond. This method of acclimatization was previously used by the small farmers in the region, but now acclimation process is done using the tank aeration method.

ii) Tank aeration method

Tank aeration method of stocking was adopted by big farmers of the state. A FRP tank was kept on pond dyke. Small potable aerators were also arranged in the tank to supply oxygen. Now the seed bags were opened and released into the tank and aeration was supplied by aerators. During acclimatization in the tank the pond water was also sprinkled. This process was done for 1 -2 hrs. After that the seed from the tank was siphoned to the pond by using 8-10 meter long 3 inch diameter flexible PVC pipe

- Feeding

After stocking of shrimp seed artificial feeds were given. Commercially available artificial pelleted feed in the market was used by shrimp farmers. The feeds are available in different sizes and varieties. The feeding was done by two methods, manually and using automatic feeding machines.

i) Dyke feeding

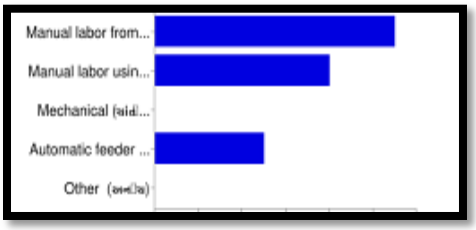
The feed was broadcasted from the dyke of the pond

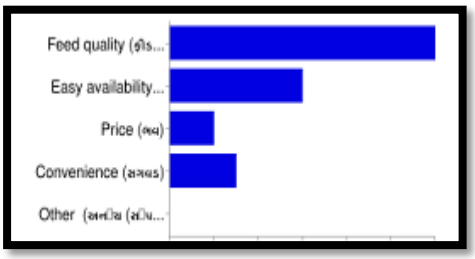
Dyke feeding by hand

i) Boat feeding

A small thermo coal sheet or steel boat was used for feeding in the pond. farmers preferred this method of feeding as it allows even distribution of feed in the pond.

Feeding using boats in ponds.

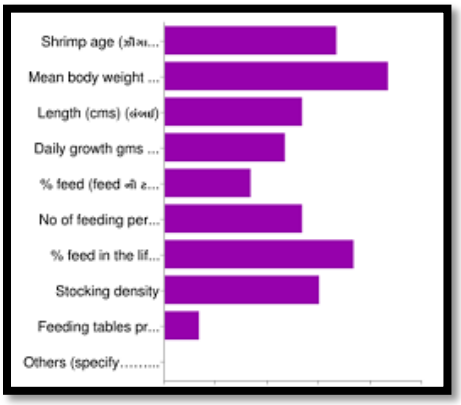




Shrimp farmers look out for better quality of feeds as it directly affects the health of the shrimps. Feeds are directly consumed by the shrimps and are converted into body mass of shrimps.

In the initial days of culture, shrimp farmers practiced blind feeding schedule. Feeding of growing shrimp after 45 - 50 days of age was followed by feed check tray management method. Feeding was provided 4 times in a day. After 50 days of culture period the shrimps were collected and the average body weight (ABW) of the growing shrimp was calculated. Based on the ABW and other factors the total requirement of the feed/day was calculated.

Feed check tray



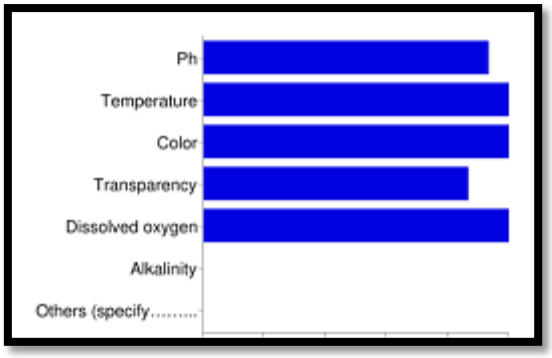
80% of the shrimp farmers look at mean body weight of shrimps for adjusting the feed quantity in the ponds. The feed suppliers also provide guidelines for feed cycle by are rarely used by the farmers as a part of their feeding cycle.

- Water quality management

The water quality parameters like pH, alkalinity, hardness, Dissolved oxygen, Ammonia, were analyzed regularly.

Water quality parameters and its optimum level

1. pH		-	7.5- 8.5
	AM(06.00)	-	7.5-8.0
	PM(15.00)	-	8.0-8.3
2. Dissolved Oxygen(DO)	AM(06.00)	-	>4.0 ppm
	PM(15.00)	-	>6 & max.10 ppm
3. Alkalinity		-	80-120 ppm
4. Ammonia		-	Max. 0.10ppm
5. Total Bacterial Count		-	$>10^5$ per ml
6. Transparency (Secchi Disc)	1st month	-	50-60 cm
	2nd month	-	40-50 cm
	3rd month	-	30-40 cm
	4th month	-	30-40 cm



The following effective measures were taken to keep the parameters in the optimum range.

- pH

The pH of the pond water was maintained in the optimum range. To decrease the pH farmers used fermented mixture of rice powder, jaggery and yeast. And for increasing the pH farmers used agricultural lime (CaCO3) or burnt lime (CaO). Most of the farmers had high pH problems except in the monsoon season

Application of lime on pond bottom (Liming on pond water surface)

- Alkalinity

Alkalinity was maintained at optimum level. To increase the alkalinity agriculture lime and dolomite were used. To decrease the alkalinity the water was stored in the reservoir before it was used for the culture.

- Dissolved oxygen

The Dissolved oxygen concentration in the pond was maintained properly. Different types of aerators were used for maintaining oxygen concentration in the pond.

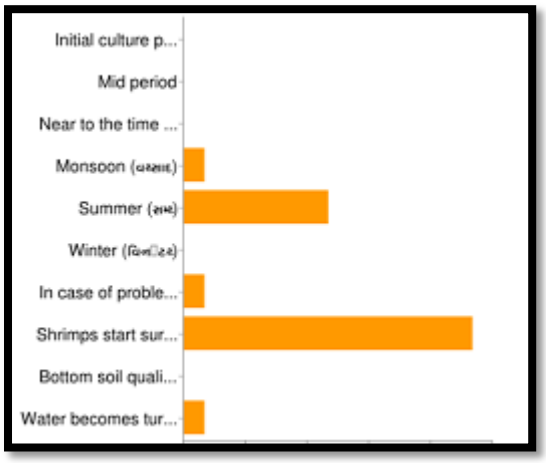
- Ammonia

Ammonia level could be reduced by exchanging the bottom water of the pond. Some farmers were increasing the aeration capacity to reduce the ammonia level in the pond water.

- Aeration

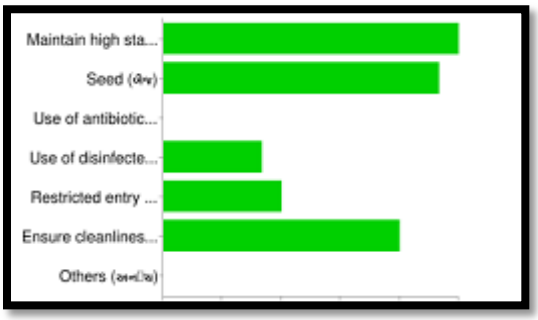
Aeration is the single most important technique for water management by the shrimp farmers. All shrimp farmers' uses aeration in their farms, however the intensity of usage differs among farmers.

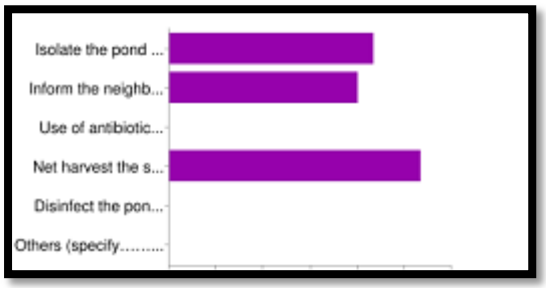
Among the available types shrimp farmers preferred surface aerators. The number of aerators used per pond varied based on the stocking density and the availability.



Aeration is provided in the ponds almost for the entire day for the entire culture period of shrimps. Aerations is considered to be the first and the most applied technique for management of any problems in the culture ponds, and it is also used to control the quality of water in the ponds.

DISEASE MANAGEMENT

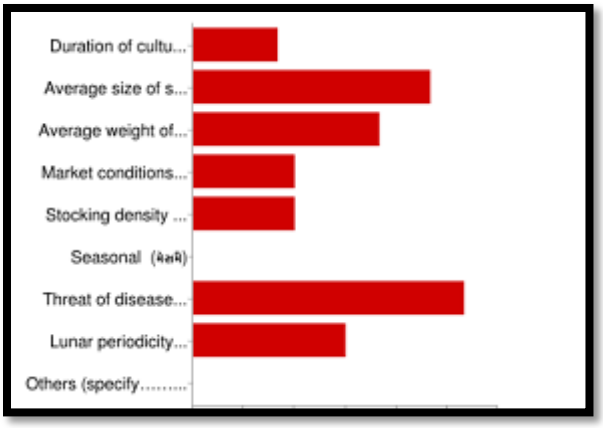




WSS (white spot syndrome) is the most common disease experienced by the shrimp farmers of these regions. WSS causes development of white spots on the body of shrimps and leads to mortality in shrimps. Along with WSS other diseases like, black & brown gill and viruses has also been causing losses for shrimp farmers of Choryasi and Olpad taluka regions over the years.

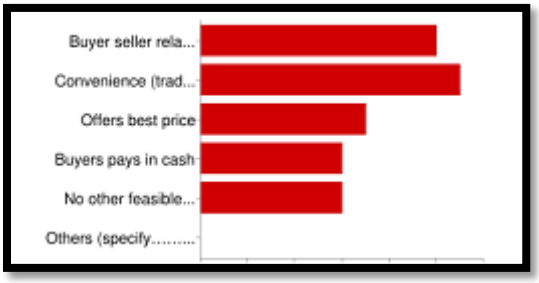
- Harvesting

Harvesting is dependent on following factors. The average size of the shrimps is most common determinant of the harvesting decisions. Along with it other factors like the threat of diseases and lunar periodicity is also considered.



After the shrimp reached to marketable size they were harvested. The most common method of harvesting was by draining the pond. The bag net was tied at the out let pipe and

the shrimps which come along with the flow of water were collected. The cast nets were also used where there was no outlet facility in the pond. Harvested shrimps were washed, cleaned and kept in chilled water (iced water)



Shrimp farmers rely on the traders who purchase the entire crop from the farmers after the harvest is complete. The shrimp farmers of the regions experiences problems like low prices of shrimps and lack of demand for smaller size shrimps.

VIII PROVISIONAL SCHEME OF CHAPTERS

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- Growth and assessment
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2.4 HARVESTING AND POST HARVEST HANDELLING

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2.6 ECONOMICS OF SHRIMP FARMING

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CHAPTER 3: LITERATURE REVIEW

CHAPTER 4: RESEARCH METHODOLOGY

CHAPTER 5: FINDINGS

CHAPTER 6: DATA ANALYSIS

CHAPTER 7: CONCLUSIONS AND RECOMMENDATIONS

CHAPTER 8: BIBLIOGRAPHY

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